03/09/98

Class	Subclass

ISSUE CLASSIFICATION

SCANNED

PROVISIONAL
APPLICATION
NUMBER

Form PTO-1625
(Rev. 5/95)

SCAN

OC

(FACE)

POSITION		ID NO.	DATE
CLASSIFIER			
EXAMINER		65723	5-14-98
TYPIST			
VERIFIER			
CORPS CORR.			
SPEC. HAND			
FILE MAINT	[illegible]	[illegible]	9-1-98
DRAFTING			

jc560 U.S. PTO
60/077428

03/0

PATENT APPLICATION

60077428

CONTENTS

Date Received or Mailed

1. Application papers.
2. (I-R
3. Request
4.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.
25.
26.
27.
28.
29.
30.
31.
32.

(FRONT)

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER
OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

CHANGE OF ADDRESS/POWER OF ATTORNEY

LOCATION 9200 SERIAL NUMBER 60077428 PATENT NUMBER

THE CORRESPONDENCE ADDRESS HAS BEEN CHANGED TO CUSTOMER # 22442

THE PRACTITIONERS OF RECORD HAVE BEEN CHANGED TO CUSTOMER # 22442

THE FEE ADDRESS HAS BEEN CHANGED TO CUSTOMER # 22442

ON 12/14/99 THE ADDRESS OF RECORD FOR CUSTOMER NUMBER 22442 IS:

SHERIDAN ROSS PC
1560 BROADWAY
SUITE 1200
DENVER CO 80202

AND THE PRACTITIONERS OF RECORD FOR CUSTOMER NUMBER 22442 ARE:

29127	30980	31071	31264	31328	31713	32020	32547	33005	33374
35536	37739	38172	38613	38942	39617	40638	40945	42460	42499
42801	43616	44189							

PTO INSTRUCTIONS: PLEASE TAKE THE FOLLOWING ACTION WHEN THE CORRESPONDENCE ADDRESS HAS BEEN CHANGED TO CUSTOMER NUMBER: RECORD, ON THE NEXT AVAILABLE CONTENTS LINE OF THE FILE JACKET, 'ADDRESS CHANGE TO CUSTOMER NUMBER'. LINE THROUGH THE OLD ADDRESS ON THE FILE JACKET LABEL AND ENTER ONLY THE 'CUSTOMER NUMBER' AS THE NEW ADDRESS. FILE THIS LETTER IN THE FILE JACKET. WHEN ABOVE CHANGES ARE ONLY TO FEE ADDRESS AND/OR PRACTITIONERS OF RECORD, FILE LETTER IN THE FILE JACKET.

PATENT APPLICATION SERIAL NO. ____________________

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

03/17/1998 ASELLMAN 00000136 60077428
01 FC:214 75.00 OP

PTO-1556
(5/87)

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
60/077,428 PROVISIONAL	03/09/98		0000	3376-21PROV

APPLICANT

DENNIS H. GREEN, ARVADA, CO; JEFF MUELLER, BOULDER, CO.

CONTINUING DOMESTIC DATA*******************
VERIFIED

371 (NAT'L STAGE) DATA*******************
VERIFIED

FOREIGN APPLICATIONS**********
VERIFIED

FOREIGN FILING LICENSE GRANTED 05/14/98 ***** SMALL ENTITY *****

Foreign Priority claimed / 35 USC 119 (a-d) conditions met / Verified and Acknowledged	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐yes ☐no / ☐yes ☐no ☐Met after Allowance / Examiner's Initials / Initials	CO	1		

ADDRESS

DOUGLAS W SWARZ
SHERIDAN ROSS
1700 LINCOLN STREET SUITE 3500
DENVER CO 80203

TITLE

METHOD OF REMOVING ORGANIC LIXIVIANT FROM COPPER SX-EW ELECTROLYTE
STREAM

FILING FEE RECEIVED	FEES: Authority has been given in Paper No. ________ to charge/credit DEPOSIT ACCOUNT NO. ____________ for the following:	
$75		☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other ________ ☐ Credit

A/Prov

PROVISIONAL APPLICATION COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(b)(2).

Docket Number	3376-28PROV	Type a plus sign (+) inside this box →	+

INVENTOR(s)/APPLICANT(s)

LAST NAME	FIRST NAME	MIDDLE INITIAL	RESIDENCE (CITY AND EITHER STATE OR FOREIGN COUNTRY)
Green	Dennis	H.	9455 West 68th Avenue Arvada, Colorado 80004
Mueller	Jeff		3462 Cripple Creek Square Boulder, Colorado 80303

TITLE OF THE INVENTION (280 characters max)

"A TREATMENT SYSTEM FOR REMOVING IONIC CONTAMINANTS FROM COPPER ELECTROLYTE SOLUTION"

CORRESPONDENCE ADDRESS

Douglas W. Swarz, Esq.
Sheridan Ross P.C.
1700 Lincoln Street, Suite 3500
Denver

STATE	Colorado	ZIP CODE	80203	COUNTRY	United States of America

ENCLOSED APPLICATION PARTS (check all that apply)

X	Specification	*Number of Pages*	16	y	Small Entity Statement	
X	Drawing(s)	*Number of Sheets*	1		Other (specify)	

METHOD OF PAYMENT (check all that apply)

X	A check or money order is enclosed to cover the filing fees		PROVISIONAL FILING FEE AMOUNT ($)	$75.00
X	The Commissioner is hereby authorized to charge filing fees and credit Deposit Account Number:	19-1970		

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: ______________________

Douglas Swartz

Douglas W. Swartz
Registration No. 37,739
SHERIDAN ROSS P.C.
1700 Lincoln Street, Suite 3500
Denver, Colorado 80203-4501
Phone: (303) 863-9700
Fax: (303) 863-0223

Date: March 9, 1998

"EXPRESS MAIL" MAILING LABEL NUMBER: EM174910973US
DATE OF DEPOSIT: March 9, 1998

I HEREBY CERTIFY THAT THIS PAPER OR FEE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE "EXPRESS MAIL POST OFFICE TO ADDRESSEE" SERVICE UNDER 37 CFR 1.10 ON THE DATE INDICATED ABOVE AND IS ADDRESSED TO THE ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, D.C. 20231.

TYPED OR PRINTED NAME: JENNIE HAMEL

SIGNATURE: Jennie J. Hamel

METHOD OF REMOVING ORGANIC LIXIVIANT FROM COPPER SX-EW ELECTROLYTE STREAM"

The present invention relates generally to leaching systems and specifically to treatment systems for removing an organic lixiviant from a leaching solution.

THE PROBLEM

The present invention generally relates to the removal of copper ions from copper ore, and more particularly to enhanced removal of copper ions using a microfiltration or ultrafiltration process which removes entrained organic from the aqueous rich electrolyte solution before it enters the electrowin tankhouse. This process improves the copper hydrometallurgical mining process through more efficient copper electrowinning.

The techniques used to remove copper from raw ore determine the overall efficiency of the copper mining operation. Hydrometallurgical copper mining operations using a leaching system and a copper extraction plant, such as a solvent extraction/electrowinning (SX/EW) plant, are now accepted processes in the copper mining industry. Currently, electrowon copper accounts for about 30% of total U.S. copper production. Worldwide, there are more than 26 major heap, dump, or in-situ leaching operations using SX/EW, with a total capacity of ~800,000 tons of copper annually. The industry trend continues towards this

technology as higher-grade ores are depleted and smelting costs increase. Other advantages of this technology, such as the ability to process low-grade ores, low labor requirements, ease of operation in remote areas, and low operating costs, make it attractive to mining companies.

"Copper hydrometallurgy", in which copper ions are leached or otherwise extracted from raw ore using liquid chemical agents, has been of interest since as early as the 17th century when copper recovery methods involving iron precipitating agents from sulfuric acid based copper solutions were tested. The hydrometallurgical circuit consists of copper leaching and copper recovery.

First, a copper leaching agent, "lixiviant", is selected for use in leaching copper ions from copper ore. Representative lixiviants include but are not limited to sulfuric acid (H_2SO_4), a combination of H_2SO_4 and ferric sulfate, $Fe_2(SO_4)_3$ (primarily for sulfide containing ore materials), acidic chloride solutions (e.g. ferric chloride, $FeCl_2$) or cupric chloride, CuCl, nitrate solutions, ammonia, and ammonium salt compositions. Sulfuric acid is by far the most common lixiviant. The lixiviant is applied to the ore (which is stacked or piled in a large heap or dump) via a sprinkler type system and allowed to percolate downwardly into the ore. As a result, copper ions are leached from the ore and collected within the lixiviant to generate a lixiviant product that consists of a copper ion

concentration (also known as a "pregnant leach solution"). The lixiviant exits the bottom of the ore and is collected. Further information regarding the lixiviant leaching process is disclosed in U.S. Patent No. 5,476,591 to Green et al., which is incorporated herein by reference.

Next, a copper recovery process is used to selectively extract copper from the collected lixiviant. Representative copper recovery processes include but are not limited to solvent extraction/electrowin (SX/EW), direct electrowinning, ion exchange-electrowin (IX/EW), and iron precipitation. Solvent extraction/electrowin is presently the most common copper recovery process. SX/EW technology was implemented in the 1960s with the development of special organic extractants for copper. The SX/EW process consists of three closed solution loops. In the first loop, the acid leach solution containing valuable copper ions and a multitude of other metal ions is fed into a mixer/settler tank where it is contacted with a copper-extracting organic liquid, commonly referred to as "lix". The "lix" preferentially extracts from 70 to 90% of the copper ions from the acid leaching feed solution. The second closed loop extraction step involves contacting the loaded organic with an electrolyte stream from the electrowinning process. The copper ions are transferred from the organic solution or "lix" to the lean electrolyte. In the third and final closed loop, the rich electrolyte flows between a cathode

plate and an insoluble anode, where 70-90% of the copper is removed through "plating". The electrochemical cell "plates" a stainless steel electrode with copper using an applied current. The copper plated cathode plates are then periodically removed from the process to obtain the solid, high purity copper product.

The copper electrowinning "EW" process must be improved to overcome inherent problems such low current efficiency, poor copper product quality, and poor copper removal from the stainless steel cathode electrode. The present invention specifically provides an improved method for copper recovery in which the entrained organic in the rich electrolyte is removed with a membrane system, leaving an organic - free rich electrolyte for superior copper electrowinning. The direct result of organic removal with the membrane process is better copper product quality. Accordingly, the invention represents an advance in the art of copper mining technology, as described in detail herein.

SUMMARY OF THE INVENTION

These and other needs are met by the process of the present invention which recovers a metal from a metal-containing material. The process includes the steps of:

(a) contacting a metal leaching agent with the metal-containing material to solubilize the metal in a pregnant leach solution;

(b) contacting the pregnant leach solution with an organic collector to transfer at least a portion of the solubilized metal to the organic collector to form a pregnant organic solution including a metal-containing organic collector and a stripped pregnant leach solution, wherein the stripped pregnant leach solution may contain at least a portion of the organic collector;

(c) contacting the pregnant organic solution with an electrolyte (or catholyte) solution to form a stripped pregnant organic solution comprising most of the organic collector and a pregnant electrolyte (or catholyte) solution comprising at least most of the copper and some of the organic collector;

(d) filtering the pregnant electrolyte (or catholyte) solution with a filter to form a concentrate containing at least most of the organic collector and a permeate; and

(e) recovering the metal from the permeate.

The process can further include the steps of recycling the concentrate to steps (b) or (c). As set forth in U.S.

Provisional Application, "Method of Removing Organic Lixiviant from Copper SX/EW Raffinate Stream," having Attorney File No. 3376-18PROV, filed October 30, 1997, which is incorporated herein by this reference, the stripped pregnant leach solution can also be filtered to recover the organic collector.

By recovering the organic collector in the concentrate, the process can reduce, or eliminate, carry over of the organic collector into the electrowinning step and can recover the organic collector from the concentrate for reuse. The substantial absence of residual organic collector from the permeate addresses many inherent problems in copper electrowinning, including low current efficiency, poor copper product quality, and poor copper removal from the stainless steel cathode electrode. Accordingly, the process provides a large, direct economic benefit.

The metal, organic collector, and leaching agent can be a variety of materials. The metal is preferably selected from the group consisting of copper, cobalt, gold, silver, uranium, nickel and mixtures thereof. The organic collector is preferably selected from the group consisting of hydroxyphenyl oximes (aka the reagents sold under the trade names "LIX-622N," "LIX-54," "LIX 63," "ACORGA P-5100," "ACORGA M5640" and "ALAMINE 336" (uranium extraction)) and mixtures thereof. The leaching agent is preferably selected from the group consisting of sulfuric acid, a chloride, a nitrate,

ammonia, ammonium salts, a sulfate, a cyanide, a thiocyante and mixtures thereof.

The filter is preferably a micro- or ultrafilter. The filter preferably has a pore size ranging from about 30Å (or 0.003 microns) to about 1000Å (or .01 microns) and more preferably ranging from about 50Å (or .05 microns) to about 500Å (.05 microns).

The filtration step preferably causes the concentrate to constitute less of the pregnant electrolyte (or catholyte) solution than the permeate. More preferably, the concentrate constitutes no more than about 50% and most preferably no more than about 5% of the pregnant electrolyte (or catholyte) solution. More preferably, the permeate constitutes at least about 50% and most preferably at least about 95% of the pregnant electrolyte (or catholyte) solution.

The permeate comprises at least most of the electrolyte (or catholyte) in the pregnant electrolyte (or catholyte) solution. Preferably, the permeate comprises at least about 50% and more preferably at least about 95% of the electrolyte (or catholyte) in the pregnant electrolyte solution.

The concentrate comprises at least most of the organic collector in the pregnant electrolyte (or catholyte) solution. Preferably, the concentrate comprises at least about 95% and more preferably at least about 99% of the

organic collector in the pregnant electrolyte (or catholyte) solution. Further details concerning the filtration step and the filter are set forth in U.S. Patents 5,476,591; 5,310,486, and 5,116,511, each of which is incorporated fully herein by reference.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a flow schematic of a preferred embodiment of a process according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The process improvements claimed in the present invention will result from utilizing a microfiltration or ultrafiltration membrane system to process the rich electrolyte before it enters the electrowin tankhouse.

As illustrated by Figure 1, a strong sulfuric acid solution 4 passes downwardly through a heap or dump 8 of low-grade copper ore and a liquid product 12 is produced which contains remaining amounts of acid in combination with metal ions. In a first loop 16, the liquid product 12 containing copper ions and other dissolved metals is fed to a mixer/settler tank 20 where it is contacted with an organic material (e.g., a lix). The organic material forms compounds with the copper ions. The mixture forms two phases--an organic phase and an inorganic phase. The organic phase is removed to form the organic solvent 24.

The inorganic phase is removed to form the acid leach solution 28. In a second loop 32, the organic solvent 24 is contacted in a mixer/settler tank 36 with an electrolyte stream 40 from the electrowinning circuit. The copper ions are transferred from the organic solvent 24 to the electrolyte stream 40. The resulting mixture forms two phases--a copper lean organic solvent 44 and a copper rich electrolyte 48. The two phases are separated with the organic solvent 44 being recycled to the mixer/settler tank 20 and the copper rich electrolyte 48 being further treated for copper recovery. In a third and final closed loop 52, the copper rich electrolyte 48 exiting the mixer/settler tank 36 is passed through a microfiltration or ultrafiltration membrane system 56. The membrane system 56 separates the rich electrolyte into two streams: permeate 60 and concentrate 64. The concentrate 64 consists of substantially all the entrained organic in the electrolyte 48. The permeate 60 consists of a substantially organic-free solution X to be sent directly to the electrowon tankhouse 68. In the electrowon tankhouse 68, the permeate or organic-free solution 60 flows between a cathode plate and an insoluble anode, where copper is removed through "plating". The electrochemical cell "plates" a stainless steel electrode with copper using an applied current. The copper plated cathode plates are then periodically removed

from the process to obtain the solid, high-purity copper product.

The concentrate 64 is sent directly back to the mixer tank 36 where the copper lean electrolyte is contacted with the copper rich organic. The organic in the membrane concentrate is reused with this method, thereby reducing organic losses. Presently, copper mining operations are trying to remove organic from the rich electrolyte by decantation, centrifuging, or coarse filtration in an attempt to maintain a high quality copper product and recover the expensive organic. For example, at one mine organic losses from the rich electrolyte are estimated at $50,000 to $500,000 per year. The economic loss due to de-rating copper quality from Grade A cathode quality is also reported as very significant by those well versed in the art. It is clear that using a membrane system 56 to remove the entrained organic offers significant, direct process and operating cost advantages. In addition, removal of the entrained organic prevents a serious safety problem in the electrowin tankhouse. Localized organic vapor build-up in the tankhouse has caused serious explosions at existing SX/EW facilities.

The membrane system 56 would process 100 - 10,000 gallons per minute of rich electrolyte, with 40-95% of the feed flow becoming permeate product (organic - free). Typical microfiltration and ultrafiltration membranes used

would be MX, G, J, K, and DS-7 series elements from Osmonics/Desal of Vista, CA. These spiral wound elements use poly acrylinitril, PTFE (Teflon), PVDF, and/or polyarimid membrane materials. The described membranes span the microfiltration/ultrafiltration membrane category, with molecular weight cut-offs of 3,000 to 200,000 MWCO and pore sizes of 0.003 microns to 0. 1 micron.

A typical system would process 1,000 gpm of rich electrolyte through 348 each 8 inch spiral wound JX membrane elements. The system would split the feed flow into 900 gpm of permeate 60 and 100 gpm of concentrate 64. The concentrate 64 would be returned to the mixer 36 where copper rich organic contacts copper lean electrolyte 72. The permeate 60, containing no organic, would be sent directly to the electrowin tankhouse 68.

What is claimed is:

1. A process for recovering a metal from a metal-containing material, comprising:

(a) contacting a metal leaching agent with the metal-containing material to solubilize the metal in a pregnant leach solution;

(b) contacting the pregnant leach solution with an organic collector to transfer at least a portion of the solubilized metal to the organic collector to form a pregnant organic solution including a metal-containing organic collector and a striped pregnant leach solution;

(c) contacting the pregnant organic solution with an electrolyte solution to form a stripped pregnant organic solution comprising most of the organic collector and a pregnant electrolyte solution comprising at least most of the copper and some of the organic collector;

(d) filtering the pregnant electrolyte solution with a filter to form a concentrate containing at least most of the organic collector and a permeate; and

(e) recovering the metal from the permeate.

2. The process of Claim 1, further comprising:

recycling the concentrate to at least one of steps (b) and (c).

3. The process of Claim 1, further comprising:

(e) recovering the organic collector from the concentrate.

4. The process of Claim 1, wherein the metal is selected from the group consisting of copper, gold, sivler, uranium, nickel and mixtures thereof.

5. The process of Claim 1, wherein the organic collector is selected from the group consisting of hydroxyphenyl oximes, alamines, and mixtures thereof.

6. The process of Claim 1, wherein the leaching agent is selected from the group consisting of sulfuric acid, a chloride, a nitrate, ammonia, ammonium salts, a sulfate, a cyanide, a thiocyanate, and mixtures thereof.

7. The process of Claim 1, wherein the filter has a pore size ranging from about 0.003 to about 0.1 microns.

8. The process of Claim 1, wherein the concentrate constitutes no more than about 50% of the pregnant electrolyte solution.

9. The process of Claim 1, wherein the permeate constitutes at least about 50% of the pregnant electrolyte solution.

10. The process of Claim 1, wherein the permeate comprises at least most of the electrolyte in the pregnant electrolyte solution.

11. The process of Claim 1, wherein the permeate comprises at least about 50% of the electrolyte in the pregnant electrolyte solution.

12. The process of Claim 1, wherein the concentrate comprises at least about 95% of the organic collector in the pregnant electrolyte solution.

13. The process of Claim 1, wherein the stripped pregnant leach solution contains at least a portion of the organic collector and further comprising:

filtering the stripped pregnant leach solution with a second filter to form a second concentrate containing at least most of the organic collector and a second permeate.

14. The process of Claim 13, further comprising:

contacting the second permeate with metal-containing material.

15. A process for recovering a metal from a metal-containing material, comprising:

(a) contacting a pregnant metal-containing solution with an organic collector to transfer at least a portion of a solubilized metal in the pregnant metal-containing solution to the organic collector to form a pregnant organic solution including a metal-containing organic collector and a stripped solution;

(b) contacting the pregnant organic solution with an electrolyte solution to form a stripped pregnant organic solution comprising most of the organic collector and a pregnant electrolyte solution comprising at least most of the copper and some of the organic collector;

(c) filtering the pregnant electrolyte solution with a filter to form a concentrate containing at least most of the organic collector and a permeate; and

(d) recovering the metal from the permeate.

ABSTRACT

A treatment system for removing organic lixiviant from a copper electrolyte solution. An aqueous copper electrolyte stream containing entrained organic, i.e. . "rich electrolyte" from a copper extraction process, is passed through a microfiltration or ultrafiltration membrane system to produce an organic rich concentrate and an organic free permeate. The permeate is fed directly to the copper electrowin tankhouse for recovery of superior grade cathode copper. The concentrate is returned to the mixer tank where the copper rich organic solvent and aqueous copper lean electrolyte are combined. The result of this membrane filtration of the copper electrolyte is removal of organic previously passed on to the electrowin tankhouse. The organic in the rich electrolyte results in decreased current efficiency, decreased copper cathode quality, difficulty in removing the copper sheet from the stainless steel cathode, and a safety concern with the explosion potential of the organic.

J:\3376\-28PROV\PATENT.017

VERIFIED STATEMEN DECLARATION) CLAIMING SMA__ ENTITY STATUS
(37 CFR 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am an official empowered to act on behalf of the small business concern, HW PROCESS TECHNOLOGIES, INC. of 1208 Quail Street, Lakewood, Colorado 80215.

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled "A TREATMENT SYSTEM FOR REMOVING IONIC CONTAMINANTS FROM COPPER ELECTROLYTE SOLUTION" and identified as Attorney File No. 3376-28PROV, described in the specification filed herewith.

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(c) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).
*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

NAME____________________
ADDRESS____________________
[ ] INDIVIDUAL [X] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Date: 1-21-98

By: H E Whatley

Harold E. Whatley
Vice President Finance and Administration
1208 Quail Street
Lakewood, Colorado 80215

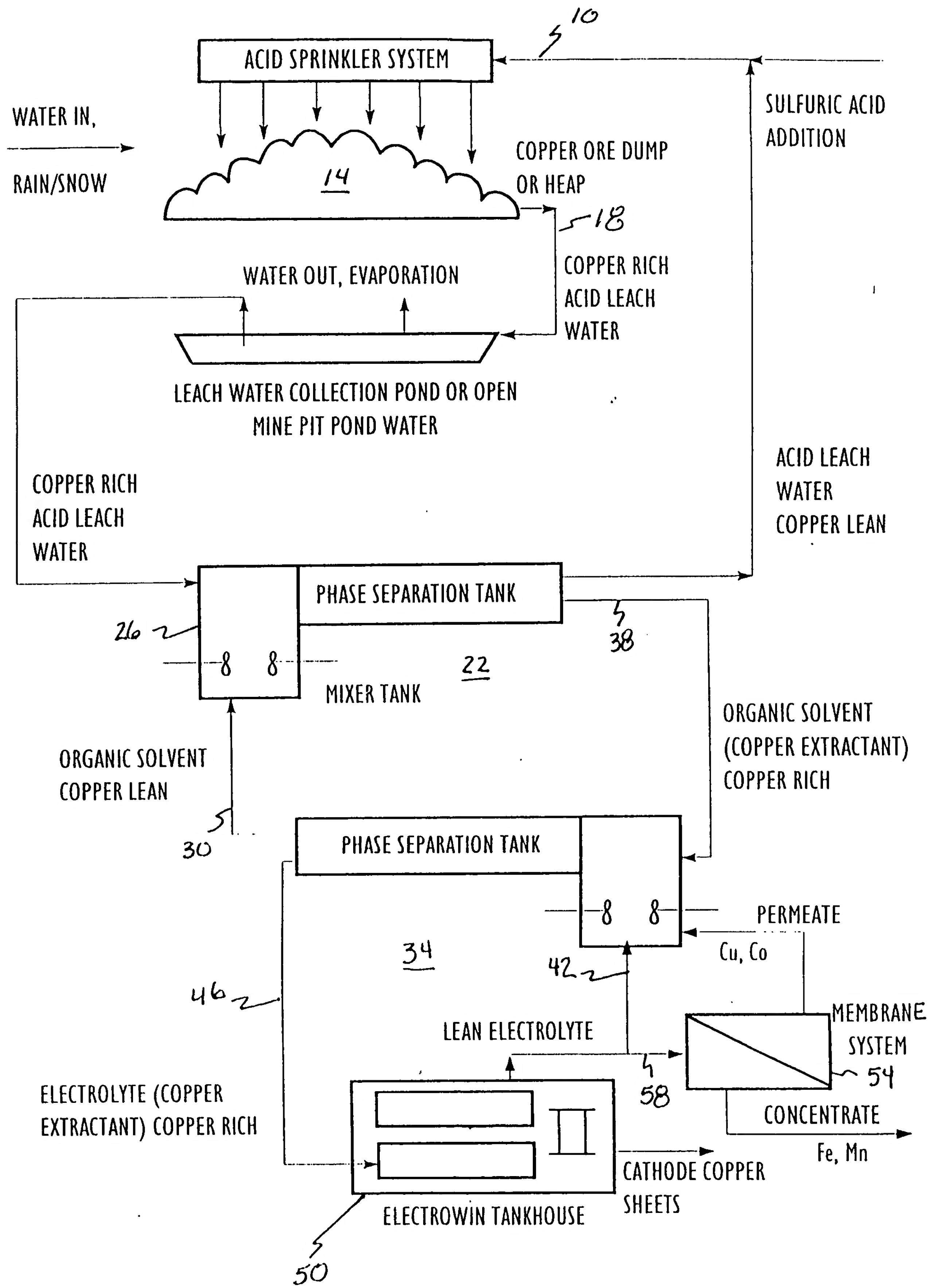


FIG. 1

JA3376\FIG1-020.GFC

0250 ... 11

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of: Lombardi	Group Art Unit:
Serial No.: 60/077428	Examiner:
Filed: March 9, 1998	CHANGE OF ATTORNEY DOCKET NO.
Atty. File No.: 3376-21PROV (As Amended)	
For: "METHOD OF REMOVING ORGANIC LIXIVIANT FROM COPPER SX-EW ELECTROLYTE STREAM"	

CERTIFICATE OF MAILING

I HEREBY CERTIFY THAT THIS CORRESPONDENCE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE AS FIRST CLASS MAIL IN AN ENVELOPE ADDRESSED TO THE ASSISTANT COMMISSIONER OF PATENTS, WASHINGTON, DC 20231 ON April 3, 1998.

SHERIDAN ROSS P.C.

BY: Janice Hanke

Assistant Commissioner
for Patents
Washington, D.C. 20231

Dear Sir:

Please be advised that all future correspondence regarding the above-referenced provisional patent application should reflect Attorney Docket No. 3376-21PROV.

Respectfully submitted,

SHERIDAN ROSS P.C.

By: Douglas Swartz

Douglas W. Swartz
Registration No. 37,739
1700 Lincoln Street, Suite 3500
Denver, Colorado 80203
(303) 863-9700

Date: April 3, 1998

09/04/1998 NTRAN1 00000008 191970 60077428
01 FC:576 25.00 CH

OIPE JC29
APR 07 1998
PATENT & TRADEMARK OFFICE

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:	Group Art Unit:
Lombardi	Examiner:
Serial No.: 60/077428	SUBMISSION OF CORRECTED SMALL ENTITY STATEMENT
Filed: March 9, 1998	
Atty. File No.: 3376-21PROV	
For: "METHOD OF REMOVING ORGANIC LIXIVIANT FROM COPPER SX-EW ELECTROLYTE STREAM"	

CERTIFICATE OF MAILING

I HEREBY CERTIFY THAT THIS CORRESPONDENCE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE AS FIRST CLASS MAIL IN AN ENVELOPE ADDRESSED TO THE ASSISTANT COMMISSIONER OF PATENTS, WASHINGTON, DC 20231 ON April 3, 1998

SHERIDAN ROSS P.C.

BY: Yvonne T. Hanke

Assistant Commissioner
for Patents
Washington, D.C. 20231

Dear Sir:

Enclosed for filing is a corrected Verified Statement Claiming Small Entity Status reflecting Attorney Docket No. 3376-21PROV.

Respectfully submitted,

SHERIDAN ROSS P.C.

By: Douglas Swartz

Douglas W. Swartz
Registration No. 37,739
1700 Lincoln Street, Suite 3500
Denver, Colorado 80203
(303) 863-9700

Date: April 3, 1998

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am an official empowered to act on behalf of the small business concern, HW PROCESS TECHNOLOGIES, INC. of 1208 Quail Street, Lakewood, Colorado 80215.

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled "METHOD OF REMOVING ORGANIC LIXIVIANT FROM COPPER SX-EW ELECTROLYTE STREAM" and identified as Attorney File No. 3376-21PROV, described in the specification filed herewith.

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(c) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

NAME____________________

ADDRESS____________________

[ ] INDIVIDUAL [X] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Date: 1-21-98

By: [signature]
Harold B. Whatley
Vice President Finance and Administration
1208 Quail Street
Lakewood, Colorado 80215

PTO/SB/68 (11-96)
Approved for use through 10/31/99. OMB 0651-0031
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REQUEST FOR ACCESS OF ABANDONED APPLICATION UNDER 37 CFR 1.14(a)

RECEIVED
JUL 25 2001
File Information Unit

In re Application of		
Application Number: 60/077,428		Filed: 3-9-98
Group Art Unit	Examiner	

Paper No. #2

Assistant Commissioner for Patents
Washington, DC 20231

I hereby request access under 37 CFR 1.14(a)(3)(iv) to the application file record of the above-identified ABANDONED application, which is: (CHECK ONE:

✓ (A) referred to in United States Patent Number 6156186 column ____

___ (B) referred to in an application that is open to public inspection as set forth in 37 CFR 1.11, i.e., Application No. ____, filed ____ on page ____ of paper number ____

___ (C) an application that claims the benefit of the filing date of an application that is open to public inspection, i.e., Application No. ____ filed ____, or

___ (D) an application in which the applicant has filed an authorization to lay open the complete application to the public.

Please direct any correspondence concerning this request to the following address:

____

____

____

Paul Benj[illegible] (Signature)

7-25-01 (Date)

Paul Benjamin (Typed or printed name)

FOR PTO USE ONLY

Approved by: [illegible] (initials)

Unit: F-I-4

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

US006156186A

United States Patent [19]

Mueller et al.

[11] Patent Number: 6,156,186

[45] Date of Patent: *Dec. 5, 2000

[54] METHOD FOR REMOVING CONTAMINANTS FROM PROCESS STREAMS IN METAL RECOVERY PROCESSES

[75] Inventors: Jeff Mueller, Boulder; Dennis H. Green, Arvada, both of Colo.

[73] Assignee: HW Process Technologies, Inc., Lakewood, Colo.

[*] Notice: This patent is subject to a terminal disclaimer.

[21] Appl. No.: 09/183,683

[22] Filed: Oct. 30, 1998

Related U.S. Application Data

[60] Provisional application No. 60/100,510, Sep. 16, 1998, provisional application No. 60/100,494, Sep. 16, 1998, provisional application No. 60/077,878, Mar. 13, 1998, provisional application No. 60/077,428, Mar. 9, 1998, provisional application No. 60/064,284, Oct. 30, 1997, provisional application No. 60/064,279, Oct. 30, 1997, provisional application No. 60/099,717, Sep. 10, 1998, and provisional application No. 60/100,497, Sep. 16, 1998.

[51] Int. Cl.[7] C25C 1/00; C25C 1/16; C25C 1/20; C15G 1/12; B01D 11/00

[52] U.S. Cl. 205/560; 205/568; 205/569; 205/570; 205/571; 205/581; 205/582; 205/605; 205/606; 210/650

[58] Field of Search 205/560, 568, 205/571, 580, 589, 594, 569, 570, 581, 582, 590, 591, 605, 606; 210/650

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,697,400	10/1972	Pang	204/106
3,816,587	6/1974	Gosser	423/29

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

WO 94/27711 12/1994 WIPO.

OTHER PUBLICATIONS

Hernandez, "Membrane Plant for Preconcentration of Copper PLS and Removal of Excess Leach Water", *Arizona Conference of AIME Hydrometallurgical Division*, 1997, pp. 1–30, (No Month).

The Nalco Water Handbook, Chapter 15, "Membrane Separation", pp. 16.1–16.4, (No Date).

Product Summary Sheet "Reverse Osmosis Elements" *Desalination Systems, Inc. of Escondido, CA*, Apr. 1991, 2 pages.

Application Bulletin "Desal-5 107" *Desalination Systems, Inc. of Escondido, CA*, Apr. 1991, 2 pages.

Eriksson et al., "Nanofiltration for Removal of Surplus Water in Dump Leaching", *Tailings and Mine Waste '96* Conference, Colorado State University Ft. Collins, Jan. 16–19, 1996, pp. 1–7.

Raman et al., "Consider Nanofiltration for Membrane Separations", *Chemical Engineering Progress*, Mar. 1994, pp. 68–74.

"Pilot Plant Studies on the Relationship between Copper Solvent Extraction Reagents and Crud Formation"; *Society for Mining, Metallurgy, and Exploration, Inc.*; Preprint No. 96–35; Mar. 11–14, 1996; pps. 1–5.

"Cross Contaminationof ODC Solvent Extraction Circuits"; *Society for Mining, Metallurgy, and Exploration, Inc.*; Preprint No. 96–162; Mar. 11–14, 1996; pps. 1–10.

(List continued on next page.)

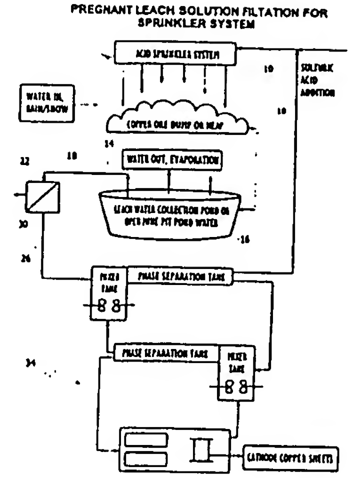
Primary Examiner—Donald R. Valentine
Attorney, Agent, or Firm—Sheridan Ross P.C.

[57] ABSTRACT

The present invention is directed to a process for removing various contaminants (e.g., organic collectors, contaminant metals or spectator ions, and/or suspended and colloidal solids) from process streams in leaching processes. The contaminant removal is performed by one or more membrane filtration systems (e.g., nanofilters, ultrafilters, and/or microfilters) treating process streams including, the pregnant leaching solution, the barren raffinate, and the lean and rich electrolytes.

33 Claims, 7 Drawing Sheets

PREGNANT LEACH SOLUTION FILTATION FOR SPRINKLER SYSTEM



SHERIDAN ROSS
A Professional Corporation
ATTORNEYS AND COUNSELORS AT LAW
SEVENTEEN HUNDRED LINCOLN STREET
SUITE 3500
DENVER, COLORADO 80203-4501

Assistant Commissioner
For Patents
Washington, D.C. 20231